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ABSTRACT

Case studies were conducted to gain a better understanding of the impact of technology in schools, focusing on schools that have had a technology-rich environment for at least 2 years. The four sites selected included a rural high school, a suburban middle school, an urban elementary school, and an urban high school. The case studies collected information under three broad categories: an organizational profile, a technology profile, and a resource profile. Observations of the four-member study teams and their inferences are reported through a cross-case analysis. In each of the four schools, adaptability was a characteristic, and this adaptability was complemented by beliefs and visions of educational technology. Technology was seen as an integral part of the educational process, rather than as a supplement, in all four schools. Each school also had a "visionary-type" leader or team of leaders who sparked the innovations. In all the schools, implementation was regarded as a journey rather than an event. All four sites experienced difficulties, but all persevered with the integration of technology and instruction. An appendix contains an interview protocol and data collection forms used in the studies. (SLD)

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# TECHNOLOGY
# CASE STUDIES

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# TECHNOLOGY
# CASE STUDIES

Prepared for the Virginia Department of Education

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April 1, 1993

*The views expressed in MERC publications are those of individual authors and not necessarily those of the Consortium or its members.

TECHNOLOGY CASE STUDIES

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## Preface

These case studies were commissioned by the Virginia Department of Education during the development of the State Master Plan for Technology. The case studies complement an exhaustive review of the literature also conducted during the development of the Master Plan for Technology. The information found in these case studies makes it possible to approach technology decisions at the school level with a healthy blend of informed instinct and analytical deliberation.

The case studies collected information under three broad categories; an organizational profile, technology profile, and resource profile. Each of these areas were further broken down into sub areas to organize the collection and recording of data. For example, the organizational profile focuses on beliefs and visions; planning; and implementation. The technology profile focuses on technology applications; instructional implications; and instructional practice. The resource profile focuses on training; administrative support; software; facilities; and teachers' administrative uses.

The project team was composed of Randy Agee, Wes Batten, Gordon Creasey, Mark Delp, Richard Kravitz, Manorama Talaiver, Jean Weller, Sherwood Wang and Sheary Johnson and John Pisapia, Project Director. Judy Scardina and Susan Goins provided able assistance in document formulation and editing.

John Pisapia, Project Director

## CASE STUDIES*

### Introduction

This study was conducted in order to gain a richer understanding of the impact of technology in schools. The team selected schools to survey most basically on the extent of their use of technology. In order to be selected for this study, a school must have had a technology-rich environment for at least two years. A second criterion was the availability of backbone networks at the school. Urban, suburban, and rural schools were all equally considered. The use of technology to support higher-order thinking skills as part of the curriculum was another criterion for selection.

Four sites which met these criteria were decided upon and were visited by four member teams. Case One is a rural high school, Case Two a suburban middle school, Case Three an urban elementary school, and Case Four is an urban high school. Three members of each team were drawn from the Virginia Department of Education's technology planning team. The fourth member was a faculty member from either Virginia Commonwealth University or George Mason University. A case study protocol (attached) was used by the site teams to guide their observations.

The four schools were examined in order to identify determinants of successful use of technology in schools. Based on team observations and on the comments from the participants, inferences were drawn which can assist schools in the early stages of technology infusion. The observations of the study team and their inferences are reported here through a cross case analysis. The narratives which follow it contain the base information collected from each site. Such information was gathered by team observations in the classroom; from the focused conversations with school staff, central office personnel, and students; and from a review of documents provided by the school.

* These case studies were supported by funding from the Virginia Department of Education.

The cross case analysis teases themes out of these narratives and draws conclusions based upon the technological situations reviewed. It examines the indicants of successful technology infusion, identifies problems encountered, and discusses the variables most important to success.

The team believes the integration of technology into the total life of these schools is the differentiating factor between these high-tech schools and others without such a technological commitment.

## CROSS CASE ANALYSES

### BELIEF AND VISION

Adaptability was a characteristic found in each of the four schools. Technology using schools tend to be open, cheery, and adaptable to change. The schools selected exemplify this adaptability. For example, one school had a change in principalship after only two years of implementation. Another school changed from traditional curricula to thematic curricula, and then back from thematic curricula to a closer approximation of traditional curricula. A third school converted from a high use of technology to a lower use of technology and from high stress to low stress technology. In its simplest terms, adaptability is the ability to change. Change, however, is never easy. It involves never ending struggle to construct, articulate, and live a vision.

Each of the four schools was well served by its beliefs and visions of educational technology. The schools presented in our study each had a vision for how technology would contribute to it. However, technology was used differently in each of these schools. Two schools openly promoted technology as a tool. One school promoted technology as a "safety net" so students would not falter on basic skills. The "tool" schools had an absence of integrated learning systems (ILSs). In the "safety net" school ILSs are present, but not to the exclusion of problem-solving and tool applications.

On the other hand, technology is seen as an integral part of the educational process -- not as a supplement -- in each school surveyed. Instructional needs drive the applications, as the schools' ideals indicated: "Children first, instruction second, and technology last," "Instructional decisions first then technology," or "Curriculum is supported by the technology."

A strong rationale for the use of technology in all schools was the belief that "technology must be a required student experience if they are to be equipped for 21st century job skills." There was little mention of technology to promote increased learning even though it certainly played an important role in two of the schools' plans.

Each school had a "visionary-type" leader, the title of whom varied. At one school it was the superintendent, at another, the central office staff. The principal took on the role at a third school. The best visionary was not one person, but a team of enthusiastic teachers and an equally helpful central office staff to create a collaborative vision.

Visionaries are important for idea generation, but we also found "keepers of the vision" who maintain the momentum through implementation. In at least two cases the media center coordinator and a few key faculty members serve this function. In another case it was the principal. A "visionary" superintendent also nurtured implementation at another school. In all cases, the principal and the media center coordinator were important to maintaining the momentum.

Beliefs and visions are the bases of several types of decisions. As we described, they determine the instructional emphases that the technology supports. They also determine the type of technology software which is purchased and used. One school made no drill and practice software available on the network. In another school, the principal refused to purchase such software. Finally, administrators expressed that beliefs and visions were a consideration in hiring new employees.

**PLANNING**

The nature of planning, while evident in three of the four schools, is diverse. One school used a 'top-down' strategic planning process which influenced curriculum and technology purchase decisions, as well as building architecture. Here, planners created an environment and then identified people who would be successful in this environment. A 'bottom-up' process was employed at another school as the principal, the faculty, and vendors all responded to a magnet school grant. The central staff strategically developed criteria at a third school, to which interested schools responded through an RFP process. In the fourth school, the size of the school and its school division allowed technology planning to proceed through informal conversations and through teacher modeling rather than through formal strategic plans. They described planning as "just in time" planning. However, strategic planning was used in this school division to procure grants for long term planning.

What seems to be important in planning is that as technology becomes more complex through school-wide information access and data management networks, the need for comprehensive planning becomes more acute.

We found the following concerns disrupt the planning process: whether or not to purchase an infrastructure to support hardware before one purchases the hardware; computer laboratories versus computers in the classroom; and as one commentator described, "Planning without access to technology is worthless." Parents and students are apparently not involved in the decision-making process.

**IMPLEMENTATION**

One reason innovation fails is that it simply is not accepted by the users. They passively or actively resist the innovation for various reasons (extra work involved, fear for one's job, lack of feeling of ownership in the innovation). Another reason for failure is that there is an inadequate support structure for using the innovation (training, supporting

documentation, maintenance). Each school confronted both of these barriers and overcame many of the obstacles facing successful implementation.

The narratives reveal that the nature of the planning can directly influence implementation. For example, disjointed implementation depends upon an informal modeling by technology-using teachers who attract others users to create a strong, if not small, cadre of technology-using teachers. However, disjointed implementation processes can lead to uneven implementation. When teachers who want to use technology are nurtured and others who do not want to use it are not penalized, assessment of progress can be more difficult.

Implementation appears to be a journey not an event. A journey that must be planned for, nurtured and guided. One school indicated that it took four years for them to integrate technology into their daily instructional program. Others accomplished it more swiftly, by using only the traditional uses of technology. Contemporary uses (tools) take longer. In fact, complete implementation was not observed in the four schools.

However, in every case there seemed to be a similar sequence each school went through. In the first two years, one could expect the following barriers to impede implementation: physical problems with the hardware (especially networks and the dependability of the equipment); lack of technical assistance and/or time to learn how to integrate technology into classrooms and teaching; funding to venture into newer technologies; and an over dependency on drill and practice software. The network "was down more than it was up" during the first two years of its use at one school.

Beginning the implementation sequence with a "change conference," or a summer training and curricular development program followed by on-site nurturing of a school-based technology committee was observed at two schools. This "focusing event" and "hand holding" strategy appeared to benefit these schools.

Teachers as well as schools go through a similar implementation sequence. They generally begin the sequence by learning to use technology as a utility and productivity tool. They elevate from using drill and practice and tutorial applications in their teaching. In three to five years teachers then usually graduate to the use of technology for problem- solving, simulations, and tool applications. These school and teacher sequences are known and dependable. They can and should be enhanced through sound implementation plans.

**TECHNOLOGY APPLICATIONS**

Instruction drives technology and is limited by it. In all cases, the schools were technology-rich with well equipped media centers. Computer automated card catalogues, CD ROM Databases, access to telecomputing, computer checkouts, VHF antennas and satellites for instructional television reception, networked laboratories, and classroom networks are all the norm for these schools rather than the exception.

The technology differs only slightly at these schools. One school has an intercommunication delivery network without a computer network, although one was on the drawing board. In another case, one computer in each classroom is connected to the school network. In other cases, there are at least four computers in each classroom connected to the school network as well as a networked computer on each teachers desk. The multimedia technology is limited particularly in the science area at each school.

**INSTRUCTIONAL APPLICATIONS**

The integration of technology into every day instruction is an "art on the cutting edge." Only a few accomplished integrators were found. Collaborative teaching and cooperative learning were evident in these schools. A significant number of teachers want to integrate technology. Telecomputing as a way to integrate technology was observed in a few classrooms. The use of the technology for delivery and tool purposes were

observed in three of the four schools. However, the traditional uses of technology still persist even in these technology-rich schools.

Only lead teachers have significantly changed their instructional practices to make full use of the technology. These teachers and the teachers in the tool-oriented schools recognize they needed new evaluation techniques. However, they feel they do not have time to develop them on their own. Traditional assessments are still the norm in each schools observed.

Keyboarding skills are also seen as a major barrier to the more sophisticated uses of technology even in the elementary school. Teachers at all the schools feel keyboarding skills should be introduced as low as the third grade. Keyboarding is a major "gate keeper" to advanced uses of computer technologies by students. It also limits teacher adoption of advanced uses of technology in their classrooms.

The placement of computers is another limiting factor in integrating the technology into instruction. In all cases, teachers want the classrooms to be more of a focus of technology use rather than having it be the labs and media centers. Yet, in one case, the classroom laboratory had been disconnected because of dependability problems. This forced teachers to start "marching their kids down to the lab." Even though they recognize the frustrations of keeping the equipment running and available in the classroom, some teachers feel going to a computer lab is a step backwards.

**TECHNOLOGY INTEGRATION**

In all cases, training and the availability of computers in the classroom are seen as significant barriers to successful technology integration. Several incentives were identified to aid in the integration of technology such as finding time to plan curriculum and to have access to computers after school and at home.

***TRAINING***

Teachers appear to have an insatiable need for more technology training. Teachers in each school cited training as a strong need, even in the schools where considerable quality training had been offered.

Technology-using teachers in the four schools tended to be self-taught and were assisted by a either a lead teacher, a media specialist, or other teachers. They placed particular value on one-on-one training from a colleague.

Training that is more specific and curricular-related was identified as the most important type of training once teachers were familiar with basic usage. Tuition support, stipends for summer training, and released time to attend training sessions were all seen as positive incentives. There was a definite bias against after school and weekend training.

**SOFTWARE**

The lack of appropriate "tool" software was identified by teachers in three of the four schools. These schools seem tied to the MECC applications. Teachers desired software from other sources, or at least better software from MECC. Even in the software-rich school, teachers wanted more and better software.

Two of the schools were hampered by inadequate budgets for software. They tended to use regular allowances for the media center as their source of funds.

There were a variety of ways software was purchased. At one school, teachers recommended purchases to the media specialist. The technology committee reviewed and recommended purchases at another. In other cases the lead teacher and media specialists advised teachers of available software. There did not appear to be any systematic review of software in any case studied.

**ADMINISTRATIVE SUPPORT**

Administrative moral support was reported as positive in all four schools. In some cases this moral support led to changing scheduling plans to gain flexibility, planning time, and more hardware and software, to form computer committees, and to seek grants to support the technology.

**FACILITIES**

An encouraging note about these schools is that three of the four were housed in old buildings that had been retrofitted for technology. While such remodeling posed its own problems such as the need for larger rooms and for electrical access and conduits for cables, they seemed to work well. For all cases, even in the new building, flexibility was a desired educational specification.

**ADMINISTRATIVE USES**

In all cases teachers perceived a net benefit to them regarding the administrative uses of technology. In some schools many administrative tasks (attendance, lunch counts, lesson planning, grading, communications through quickmail or e-mail) had been facilitated through the addition of technology.

Personal computers were valuable to teachers. Several teachers mentioned that if they ever had to teach in another school they would buy their own classroom computer if one was not provided. One special education teacher noted that the electronic IEP had reduced production time from six hours to thirty minutes.

## NARRATIVE

### Preface

The narrative that follows describes the implementation of technology at four schools. Case One is a rural high school, Case Two a suburban middle school, Case Three an urban elementary school, and Case Four is an urban high school. A demographic profile is provided first to orient the reader of the case narratives.

The **rural high school** (Case One) has 392 students enrolled in grades 8 through 12. Approximately 8% of the school's population participates in the free or reduced lunch program. The high school has one feeder elementary school. This school is near the central administration office and the elementary school which enables close collaboration between the schools and central administrative staff.

The **suburban middle school** (Case Two) has 986 students enrolled in grades 6 through 8. They are served by 65 faculty who average 37 years of age. Approximately 9% of the school's population participates in the free or reduced lunch program.

The **urban elementary school** (Case Three) has 303 regular elementary students and 18 preschool students enrolled in grades preK-5. The average age of the 22 faculty members is 30 years. Approximately 49% of the school's population participates in the free or reduced lunch program. The school is located in a renovated building in the historical area of the city.

The **urban high school** (Case Four) has 1611 students enrolled in grades 9 through 12. They are served by a 130 faculty and staff members. Approximately 10.2% of the school's population participates in the free or reduced lunch program.

## ORGANIZATIONAL PROFILE

The organizational profile is divided into three parts: belief/vision, planning, and implementation. Each of these will be addressed in turn.

### BELIEF/VISION

**Case One.** The administration's perspective at this rural high school keeps technology as transparent as possible to the students and promotes the "technology-as-tool" philosophy. The instructional needs drive the application of technology in the classrooms.

The vision for educational technology, especially computer mediated instruction, stems from the strong support and initiatives from the Superintendent of Schools. He has placed the use of technology at a high priority level throughout the two schools in the district.

While the Superintendent described his role as a facilitator responding to the needs expressed by faculty and administration, the principal and several faculty members stressed the Superintendent's role as a driving force in fostering and nurturing the technological flavor of the school.

Both the administration and the faculty held the belief that technology must be a required part of the students' experience if they are to be equipped for employment in the 21st Century. The vision for the future of technology in this district is most evident in the administration's desire to have the lowest computer to student ratio in the state.

**Case Two.** The vision for this suburban middle school was developed during a top-down planning process involving central office personnel, including specialists and directors. A planning principal was identified to implement the plan and was instrumental in researching the needs and desires of the community as well as the critical concepts and design conducive to middle-level education.

Teachers see the value of the computer in allowing them to say to students that the skills they are learning and using are those that they will use in real life -- real job skills. It was quite evident that the staff at the school are devoted to the middle school concept. They always put children first, followed by instruction, and then technology. It was also obvious that school mission and beliefs drove the selection of the hardware and software. Technology is also an area of consideration when prospective employees are interviewed, thereby proving this area was weighted during the selection process.

**Case Three.** The school's first principal set forth the founding principles of the magnet school and established the manner in which technology would be applied.

The school is in its third year of operation as a magnet school in a renovated facility. It received a grant in 1988 to begin planning the magnet. The concept was to create innovative curriculum that could be technology supported. The curriculum was developed around thematic units built on the foundation of the school division curriculum and on state and SOLS and objectives of standardized tests rather than being built around teaching discrete skills. The instructional mode was intended to incorporate experiential learning and be activity-based. It emphasized a global approach. The report card was redesigned to be based on Bloom's Taxonomy.

A change in principals was made after the second year of operation. The current principal believes in using technology to make teachers successful in what they want to do and how they want to teach. He also believes that experiential learning takes more time. Therefore, he emphasizes technology as a "safety net." It was believed that by using Josten's Learning software, students would not have basic skills deficiencies.

During the first 4 years almost one half of the faculty has turned over. The new principal and staff members' philosophy and work ethic are not necessarily compatible with the remaining six teachers who still maintain strong leadership when in the school. New

teachers to the building ask: "How do you do as much as you do?" However, the school still had a strong nucleus of dedicated computer-using teachers.

The instructional program at this urban elementary school is focused on a thematic approach using a more traditional mastery assessment model for student evaluation and reporting. A shift from the more unstructured and innovative curriculum to a more traditional approach appeared to be the result of reassignment of principals in the school during the third year of implementation.

The initiating principal mandated the use of technology in all phases of instruction, even to the point that stress became a problem for the faculty. While some of this "time requirement" has been removed and stress seems to be less of a problem, a reduction in overall use of computers in instruction has resulted.

The new principal feels that the school's faculty was faced with "too much too soon" relative to all of the technology and new model school programming. He intends to maintain the least restrictive environment for learning while at the same time wants to see more critical thinking and multimedia used throughout the curriculum. The new principal's vision for the school will require some time to fully develop and be endorsed by all faculty. From the surface, it does appear that the original magnet model has suffered from administrative changes and high turnover of faculty in the school.

There is an attempt to see that all teachers at the school are successful in their program and are involved in cooperative decision-making.

**Case Four.** The school division subscribes to the premise that technology tends to reduce the "lecture" style of education and promotes student thinking. The concept of the "smart school" is using the computer as a tool, not as a teaching device to help deliver certain knowledge and skills.

This urban high school embraced the concept of World Class Education, they are working toward providing technology as a tool for learning and working. Their goal is to provide learners with the skills to compete and excel. They are responding to the need of elevating scores based on national standards. Technology is not viewed as a supplement but as an integral piece of the educational process.

**PLANNING**

**Case One.** While there is a considerable installed base of technology in the rural school, there was little formal planning described by the administration, the media center personnel, and the faculty interviewed. Much of the planning appears to be "just in time" for the implementation phase of the new technologies involved.

This seemingly haphazard planning is viable because of the scale of the school district. There are no administrative or bureaucratic barriers between the superintendent, the principal, and the school faculty. Hence, coordination of projects requires less lead time and becomes easier to implement. The small scale of the school allows individual teachers to work on different platforms with no school-wide standard for computer-based instructional workstations. While long range planning has been undertaken to procure grants (such as the RJR Nabisco project), it was carried out more informally through direct conversations. They need not convene formal meetings by trying to coordinate several conflicting schedules within the school.

A balancing factor to the somewhat loose planning structure is the division-wide commitment to the "Total Quality Management" philosophy. Most of the administration, support staff, and faculty have attended one or more intensive workshops in TQM. Both the superintendent and the principal had become TQM trainers and had held workshops for the faculty and staff. This exposure has led them to an overall commitment to incorporating TQM as an approach in facilitating change in the school.

There was some familiarity with the six year technology plan from the VDOE, particularly in the library media center program.

The superintendent and key (technologically literate) faculty carry the majority of the planning burden in the school. In districts this small, information can be dispersed informally through teacher modeling and one-on-one conversations, rather than through formal strategic plans and objectives. This places more responsibility on the key players in the district, but as of now, the process seems to be functioning well.

This relatively unstructured approach to planning also leaves flexibility to adjust to infusions of equipment through hardware and software grants. Recently, a number of computers and accompanying software were given to the school from IBM as that corporation purchased newer, more powerful, equipment. This windfall of hardware could be more easily integrated into the district's schools because of the "just in time" planning philosophy already in place. As the technology becomes more complex (for example, school-wide information access and data management networks), the need for comprehensive planning may become more acute.

**Case Two.** The planning process and the technology plan drove some of the architecture of this new, suburban, middle school facility. Instructional decisions were made first. The belief in middle school education as being cooperative and activity-based was also an initial factor in designing the instructional program. Technology was then used as a tool to implement these instructional beliefs. Through the planning process, the central office team and the principal created an environment and found people to take advantage of that environment (they are not tending to the tool--they are tending to the purpose of education and believe that technology can amplify the power of teachers who have caught the spirit about learning). It was clear that one of the philosophies was to insure that all students become familiar with at least two different platforms.

There were many difficult decisions made in mapping out a technology plan as a result of physical matters. Examples of decisions that had to be made were whether or not to purchase an infrastructure to support hardware before a large amount of hardware was available, as well as the concept that computer labs for large groups are necessary when there are limited computers available for everyone else.

The mission and purposes come first. Teachers can catch the spirit about learning and can do some things, but resources also needed to be brought in. The approach was more important than the equipment. Based upon their observations and the interviews conducted, the study team recommends the following list be followed in planning:

1. The instructional purpose and program should be designed first, then programming to support it and the equipment should be found.

2. Decision-makers should plan for flexibility and networks.

3. Staffing and training should be a focus. If there is not a critical mass of enthusiastic teachers, implementation should be postponed.

4. A critical mass in small divisions should be created.

5. Planning should include instructional aides who can put out fires.

It was noted that the state plan for technology appeared to have an impact on the system-wide plan. The division is guided by the Commission 2000 report which has goals and targets for use of technology.

People at this school believe that the state plan should be visionary, and, since the plan has to stand for a number of years, it also should be flexible.

Every system has plans, but not every system has enough funds to make a difference. The school staff suggests allowing school systems that would do something tangible with the funds should get funding first. Tying funds to training and resource people at the school rather than pulling off talent was suggested.

**Case Three.** Extensive planning for the magnet school and a dynamic program of studies was conducted prior to the elementary school's opening. Yet the planning for the technology was done by its principal and vendors. This led to some problems. Jostens indicated that their software would run on Apple IIs even though it had never been tested. This decision still causes delays and down-time in the system.

There does not seem to be much planning ongoing presently. Technology upgrades are much needed, especially in student work stations, network infrastructure, software, and multimedia equipment.

The school was not guided by division level planning. It was evident from a central office official's interview that major planning at the district level is now taking place and will continue to impact on this and other division schools.

She indicated that the VDOE 6-year plan was a valuable initiative. They recommend that incentives be put in place for equipment and software acquisition. They also suggested an effort be made to staff a district technology supervisor and a full-time building technology facilitator.

**Case Four.** The high school's technological plan appears to be the direct outgrowth of a unique collaborative vision. It seems that the school began developing a vision to utilize technology during the mid-1980s. This resulted when approximately five to ten teachers were trying to capitalize on one computer lab. Within two years a director of technology was hired by the school division to generate a division-wide technology plan. As the central office proceeded to develop its own vision, an RFP was sent to each

division school to provide funding to selected sights for model schools using technology. The inception of the "Smart School" concept was derived from this linking of visions.

It was noted by several individuals that it seemed almost serendipitous that teacher interest in developing technology surfaced at the same time as the central office initiative began surfacing. This also seemed to correspond with the principal's interest in the use of technology in math classes which also was the topic of his doctoral thesis. A noted advantage of this hand-in-hand vision and planning was that the school received much more than originally anticipated.

The administration encourages the use of integrated packages and desktop publishing programs to develop creativity, enthusiasm, and communication skills in the students. Students are also able to see finished copies of their product in print which gives them a feeling of accomplishment. Therefore, integrated learning systems and other packaged instructional modules are not part of this high school's collection.

**IMPLEMENTATION**

**Case One.** The implementation of technology from an organizational perspective has been a rather disjointed but amazingly successful process at this high school. Initial planning precipitated out of direct partnerships with Potomac Edison, a partnership which appears to exist currently. The installed base of computers contributed through the Potomac Edison project was supplemented by the allocation of computers in the sixth, seventh, and eight grade by the VDOE computer initiatives of 1988-1990. This supplement provided a major boost to the school. Additions to this inventory were funded by grants of hardware and software from IBM and Apple.

The lack of documentation on the planning process reflects the informal nature of the administrative structures regarding technology infusion. It also makes progress assessment more difficult. For example, curriculum integration seems to be a result of individual teachers' desire to make the computer a part of the students' experience

rather than a result of any written plan. Hence, there is an uneven implementation of technology throughout the different classrooms in the school due to teacher usage.

Teachers who want to use more technology are nurtured by the school and by district administration. Teachers who are more reluctant to apply technology in their teaching are not penalized. Rather, the informal modeling by successful technology-users in the school has the effect of attracting other teachers to technology slowly and gradually. When teachers show interest, they are encouraged by the administration and the technology leaders in the school. Hence, there are no formal or identifiable planning stages present in the technology implementation.

The superintendent has been instrumental in attracting and promoting partnerships between local, regional and national businesses and organizations. These include:

- Potomac Edison
- US Air Force
- RJR Nabisco
- Apple Computer
- IBM

The district is currently engaged in a major grants program from RJR Nabisco in their "Next Century Schools" project in the elementary school. The high school administration, guidance department, media personnel and faculty celebrated the superintendent's guidance, support, and involvement in the technology model implemented at the high school.

The success of the high school is based on administrative leadership, innovative lead teachers across the curriculum, and outstanding media/library/communications lab and staff -- all operating on a small, one high school one elementary school, district. The superintendent's familiarity with the individual projects with which different faculty were

working was startling. The scale of the high school (400 students, grades 8-12) allows two or three lead technology teachers to influence the entire school culture.

The school had small class sizes (1/10) faculty student ratio) and high student/computer ratios (6 students/computer overall). Few schools have achieved a more favorable set of circumstances in these crucial variables. It is apparent that a critical number of good, appropriate, and innovative models of technology use are in place to encourage more widespread application. A significant base of technology is also available to both faculty and students so that the schools to build on its resources.

**Case Two.** Teachers expressed that they first went through seeing technology as a utility and a productivity tool. Teachers see that the technology frees up time and creates variety in the curriculum, and gives them back more academic time. Students are exposed to much more expansive knowledge.

The financial burden continually surfaced through the different interviews. A rationale was provided for looking at ways to save funds, as well as to spend them. For example, many traditional supplies, such as clocks in a classroom, were not needed because of the integrated communication network.

Some administrators felt that they had a lot of bells and whistles, and were not sure what pieces were actually essential to the operation of the instructional program. Technology is addictive. It's working with the grade books first that helps teachers and draws them into the advantages of technology. Then teachers try to find ways to work with students and the implementation process develops.

**Case Three.** The biggest barrier to implementation during the first two years was physical problems with the network and the equipment. They were down as much as they were up. The principal at the time was the main facilitator. When the systems went

down she pushed the vendors. However, at the end of the third year the service contracts were up and the cost of the new contract was $8,000.

Major barriers to more effective use of the technology already in place reflect problems with dependability in equipment, lack of technical assistance, lack of time and money to venture into newer technologies, oversubscription on the part of faculty to drill and practice software, and complacent faculty.

**Case Four.** The technology plan was developed at the division level. The library media specialists and an English teacher are the catalysts that initiated the proposal and continue to be enthusiastic about technology and keeping it alive in the school.

In the beginning stages of implementing the plan, fifteen faculty members participated in a "change" conference. Most of the using teachers had received training during their planning periods and/or during short after school training sessions for which the teachers received recertification points. All teachers are trained on Macintosh as this is the chosen platform. Teachers received computer training but repeatedly expressed the need for continued training.

There is a computer committee that solves problems that occur dealing with access and software selection. The computer committee is comprised of administrators and a sampling of teachers across the disciplines.

It was evident that the school implementation plan was concurrent with the division's strategy for a world-class education standard.

## TECHNOLOGY PROFILE

The technology profile is divided into three parts: technology applications, instructional applications, and integration. Each of these areas are covered in turn.

### TECHNOLOGY APPLICATIONS

**Case One.** A number of different technologies were observed at this high school. A small distance learning classroom area is operative with the school receiving Latin courses from the Wise County electronic classroom (VSEN).

The media center is well equipped for the size of the school. It has the following items available:

- computer automated (Novell networked) card catalog and circulation systems (two student access stations are available as well as one "main desk" access computer equipped with CD-ROM drive and Alliance Plus circulation support software)
- the Novell networked file server also has several work stations that are used in school offices to support administrative applications
- three stand-alone computer-driven CD-ROM database access stations (one is equipped with a Pioneer CD-ROM six-disc changer)
- seven Macintosh computer work stations for students (all workstations are networked to a file server which also serves as an AppleTalk LAN to most of the classrooms)
- the seven Macintoshes in the media center also have access to a network modem (i.e. Va. PEN access), to individual dot matrix printers, and have network access to a laser printer

- two single-disc CD-ROM drives are accessible through AppleTalk from all classrooms which have network access Macintosh computers (in 90% of the classrooms)

- two of the Macintosh computers are available for overnight or weekend student checkouts

- a UHF antenna for instructional television reception.

In addition to the media center, the school has a sixteen station (AppleTalk networked) Macintosh lab and a business applications lab with five (AppleTalk networked) Macintoshes and seven (stand alone) MS-DOS computers. In addition, seventeen color TV-VCR combinations are available for checkouts as well as two laser disc players and two LCD projector panels.

As mentioned above, almost all of the classrooms contain one networked Macintosh computer. The science classroom also includes two additional Macintosh computers and three Apple II GS computers equipped with probes to measure light, PH sound, etc. The drafting/industrial education classroom offers three MS-DOS computers, including one which is interfaced with a numerically controlled wood and metal cutting tool. All of these computers include some kind of CAD software, as well as word processing.

**Case Two**. A broad range of technology applications were observed in use at this middle school. Even though there is a variety of technologies, the critical mass of student and teacher-users remains relatively small. The exception is in the school-wide, televised inter-communication delivery network which serves each room in the building. An impressive array of features make this technology adaptable to many administrative and instructional functions.

There is also evidence of a student-generated newsletter using document processing and graphic software. There seemed to be limited use of Va. Pen and other on-line telecommunication services even though these are available at this school.

The technology resources available through the library and media center were impressive. The specialist displayed a thorough working knowledge of all pertinent learning technologies and promoted their application to the overall instructional program.

Distance learning was evident in a clever and versatile electronic classroom integrated into the media learning center.

Through the integrated communication system and the two labs and computers in each classroom, students and teachers have access to the tools for technology when they are ready to use them. In addition, each planning area is equipped with a computer to encourage teacher utilization.

Teachers are quite happy to be at the school where so much technology is available, as compared to most schools. They all look forward to the whole-school network, which they believe will cure many ills. At least two teachers wish to have more than one computer in the classroom. One special education teacher would like laptop computers for student take-home use. Specific equipment cited as being on a wish list are: laser disc players, classroom VCRs, an electronic microscope, color LED panels, and MBLs.

In summary, the school contains 148 microcomputers, 55 of which are networked in 4 computer labs (85 computers with hard drive, and 52 computers without hard drive); 10 laser printers; 97 color television sets with VCR capability built in and an additional 16 VCRs available; 4 laserdisc players; 1 CD-ROM player; and 3 LCD panels. The school has building wide TV distribution system connected to the school divisions electronic classroom. There is a cable drop via the Practek System. There are two modems and one dedicated telephone line exclusively for telecomputing. Telecomputing is further

enhanced by connections through Va. PEN, Applelink, National Geographic Kidsnet and Quickmail.

**Case Three.** The availability of computers in the classroom (cluster arrangements) was impressive. This configuration supports many elementary "group work station" instructional strategies. Access to the MECC collection through the various grade level LANs should provide significant opportunities for meaningful computer-assisted instruction.

The school's media center is a key technology usage area which is unusually well equipped with the following:

- a desktop publishing area featuring two Macintosh IIcx computers, two laser printer, an Apple scanner ("PageMaker" software is available), and two stand-alone computer-driven CD-ROM (both Tandy and Macintosh II) database access stations (Compton's Electronic Encyclopedia" and "World Atlas" were observed in use)

- four DuKane listening/ slide/ tape stations

- two level-one videodisc/ monitor work stations for student viewing of a representative selection of grade appropriate videodisc courseware (i.e., elementary "Windows on Science").

The center is the hub of the school's multi-fileserver LAN (Macintosh-AppleTalk) and offers the following: a UHF and satellite antenna system for school-wide distribution of instructional television; closed-circuit television broadcast capability to all classrooms; a mobile videodisc and monitor (level III capable) for check out; several LCD/overhead projection check out units; a large screen monitor (40 inch) for check out as a large group viewing station for VCR and/or videodisc.

Multimedia stations in the library media center are primarily supervised by the school's library media specialist who also prepares the related multimedia instructional units for faculty. The media center schedules 24 classes a week into the library and is open two periods each day for research/use by students.

Each classroom is equipped with closed-circuit television, UHF (public television), and satellite reception capability. Viewing is done on a large screen VCR/monitor combination unit on mobile stand. Each classroom also has between two to four Apple II GS computer systems configured in a cluster arrangement (usually four stations). All classroom student computers are networked to a school LAN using Appleshare. The standard MECC collection seems to be the primary software resource for this particular network.

Each teacher's desk is equipped with a Macintosh computer which is networked to an additional school AppleTalk LAN. An electronic mail system (quickmail) is a popular network feature. Teachers also enter attendance data, lunch counts, and lesson plans to network software/files. Macintosh computers were available on a teacher take-home loan and were highly valued by staff for personal productivity uses.

Desktop publishing was observed in the production of school communications such as a newsletter and calendar.

Multimedia applications employing technology such as the use of Virginia's free telecommunication's system, Va. PEN, computer interactive videodisc (Level III), camcorders, "Zap" cameras, or the use of Hypercard and/or Linkway software applications etc. were not observed. However, the team did observe a ten minute news format program presented by students on the schools closed-circuit television system. This is done once a week and is coordinated by fourth grade teacher.

The science classroom was not using computer interface devices with related software, but has access to the school LAN through several Apple IIGS computers. A laser printer and level one videodisc unit were present.

This elementary school has been undergoing a restructuring for technology for two and a half years. There are 191 Apple and IBM computers distributed in labs and classrooms throughout the school. There are 8 networked Apple/IBM computer labs with access to the library's on-line card catalog, electronic encyclopedia, and full-text periodicals. Two of the labs are for general use and the teacher can book its use through the media specialist as needed. The other labs are assigned to the English, Math, and Business departments primarily for use in instruction. There are four file servers which are housed in the media center. The media center also has three Apple laser printers, three laser disc players, six CD-ROM players, and three LCD projector panels. Telecommunication capabilities exist through the satellite which is housed in the media center and through the school's 19 television sets, and 14 VCRs.

In summary, the school contains 125 microcomputers networked by 4 file servers; one computer lab; 5 laser printers; 26 color television sets, 9 of which have a vcr attached; 4 other VCRs; 10 laserdisc players 5 of which are interactive; 2 CD-ROM players and one server; 6 LCD panels; and a master antenna TV and satellite dish. The school uses a Josten's ILS for remediation and enrichment, and IBMs writing to read, and it has a MECC subscription. All teachers were happy with their four-computer cluster, only one felt that additional computers would be desirable.

**Case Four.** The students have become creators of products at this high school. They are not passive listeners in the classes utilizing technology. The teacher functions as a facilitator -- not a 'knowledge pumper." The students have become teachers sharing with each other.

One example of multimedia was observed as students worked to create a presentation using a video camera and videodisc player. They also were going to use video editing equipment and were searching frantically for a video clip of the basketball team to incorporate in the production.

These high school students can communicate with elementary school students through telecomputing. It seemed to have started with a Santa project where they exchanged mail not only via telecomputing but also through the U.S. mail. At the time of our visit, the students were involved in a space alien project. The alien describes himself or herself to the elementary students who are on earth asking for guidance about the earth and its environment. This project develops creative writing, communication -- written and visual, as well as social skills. During the Santa project, 961 letters were received. Continuous access to Va. PEN was not a problem at the high school.

Videodiscs are available for sciences and social studies. However, color Macintoshes which are needed for most of the science software and multimedia presentations are on the ground floor closer to the library. This provides easy access for supervision by the network administrator who is also the media specialist. The only exception is the video microscope and MacFrog (simulation for frog dissection).

Technology integration seems to be minimal in math, science, and foreign language classes. Microcomputer-based laboratories, integrated digitized slides and simulation in scientific modeling etc. are nonexistent. The school contains 191 microcomputers, 38% of which are located in classrooms and the remaining 62% located in 8 computer laboratories (15-17 to a lab). Four file servers support 2 local area networks with 6 CD-ROM drives and connective media (satellite, broadcast and cable TV, modem and microwave) that can move voice, video and data in and outside the building. Nineteen color TVs, 14 VCRs 3 laser disc players support these connections. A standard coaxial cable connects all rooms in the building. Dot matrix and 3 laser printers are available on the network and are placed at various places in the building. The school uses the

Alexandria Library Management software, Dialog, and Va. PEN as networked resources. Stand alone tools include Grolier's Electronic Encyclopedia, NewsBank, Level III video discs and RGB and LCD projectors. The school is supported by a MECC subscription. The electronic classroom is equipped with a steerable satellite dish, speaker phone, fax machine, and networked computer work station.

## INSTRUCTIONAL APPLICATIONS

**Case One.** In the classroom, technology is used both as a delivery vehicle for instruction (computer as tutor) and for a variety of other tasks (computer as tool). At the time of the site visit, only the lead teachers in technology had made significant changes in their instructional practice because of technology. The drafting, English, and science teachers had remodeled their courses to make use of computer technology. There are plans to develop some new course offerings in the high school that would capitalize on interdisciplinary approaches. Courses integrating home economics and technology training, and joining mathematics and problem-solving statistics are two of the planned courses.

A significant use of word processing software was cited by tenth grade teachers of English, of science, and of industrial arts teacher, by the school newspaper advisor, and by two teachers in the business education department. Graphics software (Cricket Graph) is used in the preparation of science projects. Microsoft Works and Pagemaker are used in the production of the school newspaper and yearbook (two different instructors).

Microsoft Works seems to be the key item of software for the introduction of spreadsheet and database concepts in the business education classes. Computer Concepts and Business computer Applications were cited as very popular courses.

The use of interface software and hardware by the earth science/physics teacher was extensive and innovative. (This teacher received a Christa McAuliffe fellowship for his

work in this area.) The use of sophisticated gradebook software was reported by at least one teacher (Spanish). Software/hardware access to Va. PEN is available through the library media center and the science area; however, this is used primarily by teachers and not by students.

The lack of keyboarding skills by most students is a problem in effectively using word processing software. Most of the faculty feel that this skill should be taught to all students in the middle grades.

**Case Two.** There were no observations of computers using problem-solving at the middle school. Several of the teachers interested in using technology to teach higher order thinking skills noted they need to develop new evaluation techniques, but do not have time to do this on their own.

The technology applications allows gifted students to go quicker while they can spend more time with students who need help. Technology impacts their teaching style or reinforce the style they are currently using. Block scheduling is extremely important and enhances the use of technology.

Students were observed in small cooperative learning groups in most classes. Most notable were students engaged in projects using Hypercard. Even though a smaller number, students were developing their own stacks, subsequently teaching other students to do the same.

Keyboarding skills are a big limiting factor. It is a disadvantage when students hunt and peck. Teachers agreed that students need to learn keyboarding skills at the elementary level, and suggested implementing a pilot program.

Telecommunication simulations are done by faculty through group instructional formats using LCD projection devices. While these formats are used, at the time of our observations, they are not being used often.

It is technology that is seen as an important tool for learning.

In the sixth grade, two classes are working through the Va. PEN academical village. All students view CNN newsroom each morning. Two teachers instruct students to use Hypercard for projects and presentations in language arts and social studies. In the seventh grade, one teacher uses laser disc instruction for science; another uses computer software in preparing the school yearbook; and several teachers help students to produce the student newspaper. In the eighth grade, mini-labs are being used for special instruction on the literacy passport test.

Instructional plans are to move teaching keyboarding skills to the third and fourth grade level to enable more sophisticated use of technology upon middle school entry.

Lack of keyboarding skills for sixth and seventh grade students was pointed out as a real limiting factor in the language arts and social studies areas.

Several of the teachers feel quite ready to go beyond drill and practice to more open-ended software. These same teachers are also excited about interactive videodiscs, robotics and MBLs. However, other teachers interviewed were more interested in CAI software that was specifically geared to the curriculum and matched to current textbooks.

Drill and practice software (most MECC) is being used in a traditional way by a broad mix of students. Learning-disabled students use CD-ROM, on-line databases, and other library automation and cataloging in the library. There were no records kept, however,

of the usage. Through two trips into the library, just a few students were seen operating the units. Audio-visual technology is available to everyone however, and is being used.

**Case Three.** One second grade teacher (a 2-3 cluster leader) uses a significant amount of software ("Bank Street Writer" and "Appleworks") to support writing process instruction to the degree of not using a language arts textbook in the traditional fashion. While agreeing to the value of these pieces of software, a fourth grade teacher did not appear to be employing a significant amount of CAI in writing process instruction.

Computers in classrooms appeared to be used mostly in a drill and practice mode, utilizing the MECC software collection. No widespread use of software for tutorials, simulations, problem-solving and/or "tool" applications (database, graphics, spreadsheet, etc.) was observed.

One special education teacher cited his success with basic simulations and problem-solving programs such as MECC's "Oregon Trail" and "Lewis and Clark Slept Here."

The ILS lab is used for group instruction on keyboarding with the Jostens' keyboarding program. However, at least a 20-hour keyboarding unit (touch typing) appeared to be taught on a sporadic basis to fourth and fifth graders. Its connection and follow-up with language arts activities on computers was seemed unconnected and was unclear. The lack of minimal keyboarding skill by most students still appeared to be a problem in efficiently utilizing word processing software.

No software/hardware for access to telecommunications (i.e., Va. PEN, "Kidsnet") is available.

After a "rocky" first two years with Jostens' ILS (technical and network problems), a dedicated lab is now apparently in use effectively. According to the administration, it is used as a "safety net" for basic skills instruction. Upper elementary students use the lab

for group class and individually for remediation on a daily basis. Significant passing percentages on Virginia's LPT seem to be a very high priority for the school. The elementary's school's principal attributes the rise in standardized test scores for the school is due to the addition of computers to the curriculum. One teacher believes the lack of immediate feedback from Jostens' software in addition to the cutting off of the distributed network, discourages teachers to continue use of this software.

Two special education teachers were interviewed (ED and LD). Both indicated a significant role for computers in their instructional strategies. One teacher cited very effective use with large group instruction (i.e., LCD/overhead unit).

Both art and music classrooms have access to computers. No activity was observed. The significant use of instructional television varied, but appeared to be significant in grade 2-3 cluster). Satellite and cable programming are available but are not significantly used.

The school has discontinued its use of previously dedicated IBM "Writing to Read" lab because an aide could not be assigned to support this program.

Technology is now viewed as a safety net in the instructional program rather than as an instrument to stimulate instruction.

Instruction drives the technology that is in place, but also seems to be somewhat limited by it because of a lack of more state-of-the-art hardware and software. Key instructional leaders in the school recognize that the classroom **should** become more of the focus of technology use rather than continuing the technological focus on laboratories and library media centers.

A dedicated Apple IIGS (Appleshare) lab is used during the day for basic skills instruction/remediation with Jostens' ILS. Second through fifth grade classes seemed

to be the primary users of this system, as students spent 20-30 minutes a day on a class rotational basis. In grades two, three, and four, every student cycles through twice daily. Fifth-grade students cycle through once a day. Several teachers indicated that lower quartile students with remedial needs were often sent to the lab on an individual basis.

**Case Four.** It has taken more than four years for this high school to integrate technology in instruction. The teachers get one-on-one training from the technology facilitator during planning periods.

While there is full integration in English, journalism, and business classes, it is necessary to bring the same balance across the curriculum. For example, Mathematics teachers have integrated Explorer and graphing calculators in their instruction. They have classroom sets of both types of calculators. In fact, they have taught themselves and have attended training sessions outside the school. In order for these math teachers to fully integrate, there is a need for additional training in the use of a variety of math software and pedagogical approaches to the use of software in secondary math instruction. Even though the school has purchased Geometer's Sketch Pad and Theorist, top-rated software in secondary mathematics, teachers have had training only for an hour in the use of these products. These products require at least five to six hours of training to properly understand and integrate them in teaching.

**INTEGRATION**

**Case One.** There was a small, but highly talented nucleus of competent technology teachers here who are committed to reshaping instruction through technology at this rural high school. The integration of computer mediated instructional programs varies widely from teacher to teacher.

The tenth grade English teacher had experience with computers in her preservice and was very enthusiastic about the importance of computers in the language arts area. She

depends on the use of computers in the library and the multipurpose Macintosh lab (16 computers) to maintain high student/computer ratio in her technology intensive lessons.

The industrial arts/drafting teacher uses three MS-DOS computers in his room to instruct students in the use of specialized equipment (some donated through corporate collaboration) for the design and production CAD projects. He also uses parts of the same system to produce the school yearbook.

The two business education teachers use both MS-DOS and Macintosh platforms to teach management and budgeting with spreadsheets on the twelve computers in the business lab.

The McAuliffe awarded science teacher had five computers (3 Apple IIGS and 2 Macintosh) in his classroom which he uses for investigations and reports integrating word processing, graphics, and scientific concepts.

Some members of this core use group used word processing to add "corrective notes" to students' work so that students could revise their work and add it to portfolios for alternative assessment without retyping. Lead teachers also employ collaborative (peer editing) and cooperative learning (science projects, newspapers, etc.) to complement their use of technology.

Another group of teachers were moderate users of technology overall, but had not radically changed their instructional delivery methods. They utilized the media lab more frequently because the staff could guide and trouble-shoot for individual students and/or small groups when technology-related problems occurred.

A third group of teachers have baseline literacy skills but use computing beyond word processing mainly for managerial tasks. These teachers have one or two networked Macintoshes (most without a hard drive) in their classrooms.

**Case Two**. Technology integration in the middle school primarily follows by using video-taped instruction from cable in the classroom, videodiscs in a level-one mode in science classrooms, word processing software for writing samples, and Hypercard for developing student-generated units. Collaborative teaching seemed to play a role in the organization and development of these units of study. The sixth grade teachers outlined a progression in learning about student-based technology – from utilitarian software at the beginning, to curriculum-based software, to open-ended software like Hypercard, simulation, etc. They have barely reached this last step here, which they charge is mainly due to lack of availability of the correct type of software.

**Case Three**. While use of multimedia in the library media center was varied and appeared related to classroom instruction (library serves 24 classes each week), individual teachers' use of multimedia was minimal. It is obvious that faculty need training on multimedia hardware/courseware so applications can begin moving from the library media center into the classroom for more effective and timely curriculum integration. The faculty reported that there is not enough time to appropriately integrate the technology.

The Jostens' basic skills software resource (ILS lab) are used in a coordinated fashion with classroom activities. Management reports from the system are considered useful, but are not immediately available.

Technology appeared to promote cooperative (peer editing and multimedia work group units, etc.). At least one example of collaborative learning was illustrated with teacher-student produced closed-circuit television programs.

Student use of electronic research tools (CD-ROM databases and videodisc courseware) is apparent. This seems to partially confirm teachers' claims that technology is significant in promoting the school's movement toward a thematic instructional focus.

No examples of changes in student assessment which might be promoted or facilitated by technology have been reported, or observed. Students still tend to be evaluated through the innovative report card and standardized tests.

**Case Four.** Instructional practice at this urban high school indicates a commitment to cooperative learning and collaborative teaching models. The faculty is concerned about the focus on drill and practice. An outstanding correlation of software and curriculum, and effective evaluation procedure was evident from the documents provided by the administration.

Student progress is approached in a more traditional context. Attention to alternative assessment models such as portfolios and performance-based measures are suggested. But it the technological focus is not on students using technology to create knowledge.

Technology is used as a tool to teach. The council leaders of the school devote time on each agenda to the technology. There is open enthusiasm which is a key to their success.

Most teachers think that more training in curriculum-specific applications is the key to better technology integration. More lab availability is also strong need for better integration.

## RESOURCE PROFILE

The resource profile is divided into four parts: training, software and applications, administrative support, and facilities. Each of these areas will be covered in turn.

### Training

**Case One.** As mentioned earlier, the lead teachers and the media specialist provide the vast majority of technology training (usually informally) to the rest of the faculty. Some of the lead teachers either arrived with the skills necessary to use technology or learned

it independently of the school-based inservice programs. The administration does provide one-half of the tuition for faculty pursuing graduate (MA) degrees at Shenandoah University in approved areas.

Despite the availability of role models and relatively complete technology base, many of the teachers interviewed cited the need for additional school-based training in computer-use. All teachers recommend release time or paid stipends over the summer and do not prefer weekends or after school times for scheduling inservice and continuing education programs.

The media center coordinator and a few key faculty members maintain the momentum of technology use in the school. These leaders are largely responsible for suggesting staff development opportunities and modeling appropriate technology use which encourages other teachers to experiment with new technology-based instructional methods. Their role as stakeholders in the technology is quite evident in the school.

Other staff development opportunities included courses taught at the high school which could lead to a master's degree program through Shenandoah University.

**Case Two.** Teachers here learn from other teachers and from computer courses. When one person is trained in a program for content for a grade level, he or she becomes the staff expert on that program. Most teachers expressed a preference for one-on-one training they get from their colleagues.

The school division offers much quality training, but two teachers received most of their training through higher education courses and would like more offerings in this area.

Teachers expressed a strong need to have time to just play with the software. Although planning periods are available, they are still not long enough to really get into exploring a new piece of software. All teachers specifically noted that training should be very

technology or software-specific. It should be presented continuously over time, as opposed to the current model which is usually about one hour of inservice training on several different topics.

The staff has been benefitted from private assistance with training from Signet Bank, but were concerned about the lack of available resources for further learning about new uses of technology. They work through their grade level councils to support and train themselves. One teacher first taught twelve students how to use Hypercard. These students in turn individually taught twelve other students.

**Case Three.** All teachers interviewed feel comfortable using technology. All began teaching before current technologies were introduced into the instructional program. Therefore, these teachers found it necessary to learn new methods for the application of technology in the classroom. Some novice teachers indicated they took a course in computers in college which was designed much like integration of audio visuals classes were introduced in the past.

When the elementary school selected staff for the magnet school, each teacher selected spent a full summer in staff development programs which enabled them to better serve the magnet model and utilize the technology incorporated in the school.

The initial group of teachers received training in the first summer of the school's operation. Most report, however, that they are self-taught.

The ability to check out computers was important to their development. In fact, several teachers indicated that if they ever changed schools they would purchase a computer if one was not available.

Additional future training is important. Training should ideally be accomplished during released time and not on weekends or after school. Possibilities suggested included summer workshops with stipends.

Teachers reported they were trained to feel comfortable with the technology in the first year. As they moved into more advanced uses (i.e. interactive forms and laser disc) the second year, less training was offered except on an individual bases.

All teachers said they had received training on a specific software program or system. These teachers were quick to point out that they were a part of the original team who were present when the school began their program four years ago. Many new teachers have not received training while the total level of technology use has decreased.

Teachers mentioned that there is a need for additional school-based training on appropriate uses of technology.

The Library Media Specialist has her degree in Instructional Technology from Arizona State University. She frequently provides assistance to teachers in the use of technology. There is a feeling that she is responsible for too much of the training and technical assistance.

The District Computer Coordinator emphasized that a program to provide additional training to a few teachers in each building is in the planning stages.

**Case Four.** Teachers noted that they learned much of what they knew from colleagues in the teacher support computer laboratory. Most training has been on specific productivity, research, and utilities software packages. Training was provided by school personnel. In fact the key trainer in this school is a full-time English teacher who is now a part-time technology trainer.

All teachers interviewed felt the strong administrative commitment and support but cited the need for more training. The central office technology person first felt that after initial start-up training demands would decrease. Such has not been the case. As more training is conducted, even more is requested.

Most of the training is conducted during planning periods or after school. There have been some 40-hour summer institutes offered through the Consortium for Interactive Instruction. Four or five half-days are being incorporated into next year's instructional calendar. Several teachers pointed out that having multiple-computer teacher support has promoted a lot of colleague "sharing" of technology ideas and training.

Teachers on staff who are trained come back and are resource persons on the property.

**SOFTWARE**

**Case One.** The use of software is heavily mediated by the school-based lead teachers and the media specialist. They offer advice and ideas about software selection and use. Many took advantage of the thirty day return privilege to review software (a standard practice) before buying it.

**Case Two.** Almost all those interviewed agreed that they choose software to match their current curriculum, but were restricted by the software available at this school.

Software selection is driven by teacher choice in support of the content.

The county is a member of MECC software consortium. This makes it a popular resource, but also an area of complaint from faculty which would like more innovative instructional software than the traditional drill and practice format of most MECC products. They feel more suitable software developed for the Macintosh would greatly benefit their instructional program.

The initiating principal mandated the use of technology and had the final say on which software was purchased for the school. It is said "she hated dull and practice software." An 8:30 AM to 7:00 PM work load for teachers was not unusual the first two years of the school's operation. The principal and teacher tries to do everything at once, and consequently, stress level were high.

Magnet school funds were plentiful in the first year but the budget for the media center was a modest $2,000 a year for books and software. There was an additional allocation of $1,000 to the principal to use in support of technology.

**Case Three.** The elementary school has attempted to secure the types of software utilized by local business and industry in order to better prepare students for entry level positions. This software in many cases is preferred over similar software produced for school use. An example was using "Desk Top Publishing" instead of "Ready, Set, Go."

By design, very little traditional CAI software is available on the network.

In addition to Hypercard, other software is available for faculty to utilize in instruction. However, despite a two page list of available software, faculty is still requesting additional purchases. The media specialist remains open to making these purchases as funds become available.

Each teacher has the opportunity to select the software needed to integrate technology into instruction. The school's technology application includes Alexandria software for the catalog. Clip art collections, Page Maker, Word, Works, and MacWrite seem to have frequent uses by students in journalism and English classes.

**Case Four.** The Library Media Specialist frequently provides information about available software from journals, magazines and mailings to the school.

All teachers review software before attempting to use it in their classroom. Several take advantage of software companies' 30-day free preview policy to examine potential software.

All of the teachers feel the available software has definitely modified how they used textbooks.

Teachers feel the Jostens Lab and related software are effective, but would like to have money to purchase additional programs specifically for their classes.

**ADMINISTRATIVE SUPPORT**

**Case One.** Teachers recognize the personal interest taken by the superintendent and principal in facilitating the innovative uses of computer-based technologies, including a continued effort to bring more hardware/software into individual classrooms. They have established a close collaboration and partnership with several regional and national companies to bring in extra resources.

As the superintendent stated, "Planning without access to the technology is worthless." According to him, both staff and student access to computing equipment (hardware and software) has to remain a major focus of his efforts in educational transformation in his district. Because of this strong belief in technology integration, there is a long term commitment to expanding technological opportunities in the school program. This was evident in the comments from administrators, media center personnel, and faculty interviewed during the site visit.

The major organizational facilitator of technology in the school was the library media director, a self-taught technology specialist. She trained herself to use several technologies which are available at the school, including Va. PEN, CD-ROM databases and other microcomputer applications. Aside from running the media center, she has written several grants which resulted in several equipment purchases in the media center

(described in the technology profile) and also informally instructed faculty in the use of these facilities.

**Case Two**. Most felt the flexible schedule at the school helped in two ways -- real planning periods helped teachers use technology for themselves, and block scheduling allowed teachers to use technology in the classroom.

Support from the principal is very high. A "technology committee" publishes an informational newsletter periodically, which helps keep everyone informed of new acquisitions and applications. There is not one 'technology person' per se, though several teachers have a more-advanced, technology-trained teacher to whom they turn frequently for support. The drawback in this is that teachers who give this support can only do so much since they have a full teaching load (this note comes from two of the teachers who are often called upon for help).

The central office is extremely supportive and makes instruction available to the staff when needed.

**Case Three**. All teachers feel that the administration supports the use of technology in the classroom and recognizes the need for continued improvement, even though the philosophy of the current administration is markedly different from its founding principal.

There is no longer someone in the building to provide computer support, other than the media specialist. The school had a full time technology coordinator for the first several years of operation, who was reassigned to other magnet schools. Teachers cited a need for at least a half-day computer support person.

The library media specialist has played in the past, and continues to play, a major role in technology leadership. The resources of the media center (some devices remain unopened) need to be more fully implemented in the classroom. Teachers must become

more self-reliant in identifying and executing uses for the learning technologies in the curriculum.

The library media specialist is a critical factor in the utilization of the multimedia and computer facilities of the media center as well as in supporting technology use in general. She essentially functions as the building technology coordinator in addition to being media specialist. The team believes this is not a desirable combination of duties as both jobs are normally full-time positions.

Initially, maintenance work was contracted out as needed. As the equipment became older an in-house capacity was established. Computers are now repaired by a person in the central office rather than a dealer service department. This may be an inefficient method since it can be time consuming to get broken equipment back.

**Case Four**. The school system made a commitment to technology by appropriating all of the funds to implement the technology plan. However, they are now at the stage of applying for grants to further implement the project. They have purposefully not sought funds from industry because they did not want to be limited in carrying out their plans.

Teachers feel the principal is very supportive of all types of technology utilization in the classroom. The principal in fact set up a computer committee to help make many technology decisions.

All teachers interviewed feel the two school media specialists offer excellent computer support, particularly the assigned network administrator. One media specialist spends most of her time in the various computer labs supporting teachers and students. The other media specialist is in charge of the Alexandria library system.

Computer use is also supported, on site, by an English teacher/technology trainer who has been assigned two periods per day to support computing activities.

In addition to the "on-site" support, the central office provides: technical networking support, a library teacher, a division technology specialist, and a part-time technology assistant for teachers and students who also taught part-time. Each of these people provide some support to the school as well as to all the other schools in the district.

In considering maintenance and other operational problems, using school system personnel is the preferred method. A full-time technical person was hired to care for the technology needs of the school division. The rationale was that the schools would not become dependent on slow service and maintenance of a private company. They do, however, have an association with a computer company called Connecting Point, Inc.

**FACILITIES**

**Case One.** The high school has an excellent student/computer ratio. It is currently 6:1. Still, teachers feel the need for more computers in their classrooms to effectively use computing. Other items requested included making rooms more computer-friendly by using tables instead of desks and improving the number and placement of outlets and phone lines/jacks.

**Case Two.** Outlets weren't well-placed to make the computers easy to move around the classroom. They tend to be by the door or by sinks. Several teachers mentioned access to phone lines would be nice.

**Case Three.** All teachers cited a need for additional classroom space. Logistical problems experienced may be facilitated by wall mounting video equipment.

When renovating old buildings it is important to provide for maximum flexibility. Some times local architects are not in tune with technology needs. And strict adherence to the code requires flexibility. Teachers mentioned telephone jacks, worktables rather than desks, a video area with a big screen TV, more CD-ROM's, space for listening stations, and some laptop computers as desirable additions.

There are major changes in the configuration of network servers on the LAN planned for the near future. Need for more assistance with the daily technical servicing of the hardware and software was cited by a significant number of staff members. Repair of equipment takes much too long under the existing plan.

**Case Four.** Because the technology plan was implemented in a 24-year old building, electrical wiring had to be installed in rooms that were to become labs and cable had to be installed throughout the school if networking was to be possible. The biggest problem pointed out by the technology leaders was the most feasible location for labs. It was finally determined that labs should be housed in the same general area to avoid extensive wiring as well as to provide easier access from the media center whose staff supervises the labs. The actual room arrangement was also changed several times before a suitable one was found.

**ADMINISTRATIVE USES**

**Case One.** All of the teachers interviewed used the computer in their room to partially automate grading, management, and word processing tasks. Teachers also used the telecommunications resource to access Va. PEN and other university-based information resources (card catalogs, inter library loan, etc.).

**Case Two.** All the teachers use the computer for some sort of administrative tasks, varying from simple word processing to specific utilities like gradebooks or calendar markers. One teacher uses it for the yearbook and was very happy about how that system worked.

Faculty are using personal productivity software, but there are a few resistant faculty who believe it takes more time to use the computer than it does to use the calculator in developing grades.

**Case Three.** Teachers keep all tests, chapter notes, correspondence, and student data on computers. Some teachers keep their grades on a computer but still need to fill in preprinted report cards. Teacher lesson plans are placed in computer folders. While they are available to the principal, he does not review them to see how often different software applications are utilized.

The accessibility of computers on each teacher's desk (Macintosh) for materials production and administrative work is greatly valued and appreciated. Teachers stressed a personal time savings of 3-4 hours for each IEP constructed using special software.

**Case Four.** All the teachers have been taught how to use the computer for such administrative tasks as word processing, gradebook, and calendar. This serves as a good introduction for the teachers.

The principals and guidance counselors employ technology in their administrative tasks. In addition, the in-school suspension teachers utilize the computer to track data on students sent to their program as a punishment. This data includes infractions as well as which principal sends the most students to this program.

The school is networked with an integrated communication system which provides a clock bulletin with video display in all offices, classrooms, and common areas of the school. Announcements are provided daily through this format. Televisions and telephones are available in each classroom and provide a means of video and audio retrieval from cassette sources, live video retrieval, and cable distribution.

A classroom teacher may share a distribution or video cassette recording through the distribution system rack located in the media center. The video is called up by using a classroom telephone and is seen on a color television in the room. The classroom telephones are inside extensions for the entire building.

There are two computer labs. The content computer lab is a networked Macintosh lab with a file server used to support the academic core. Software is chosen by the teacher to support the curriculum and the utilization is facilitated by a computer lab aide. The computer lab for exploratory keyboarding and word processing is a networked IBM MS-DOS platform and file server.

In addition to these labs, there are Macintosh LC computers and printers in each classroom. It is the intent of the administration that these be networked within the school to make technology as accessible as possible within the next year.

# APPENDIX

# CASE STUDY PROTOCOL

## CASE BOUNDARIES

The purpose of the case studies is to identify examples of technology usage that promote the implementation of the core curriculum and world class standards.

## SELECTION

The Department of Education nominated a group of schools for the case study team to select from. Their nominations were thought to be leading technology-using schools, each with an enabling network structure in place, and it appeared to be making a difference in how instruction was delivered in the school.

After discussion, the case study team selected four schools to visit: one elementary, one middle school and two high schools. Together they are rural, suburban and urban in nature. Each school has the technology in place: 1) Enabling infrastructure i.e., local area networks; 2) Distance Learning; 3) Library Media Center. A list of schools is attached.

## PROCESS

A study team composed of three project 91-90 members and one university consultant were identified to visit each school and develop a description and examples for the entire case study team to review. The teams are identified.

The site visits include: a review of documents, focus group interviews, individual interviews, and classroom observations. Each visit will be coordinated by the individual from the project team identified. The visit coordinator will gain access to the site, and be responsible to assure that proper protocols with the school are followed. They will notify team members of arrangements including travel. Each participating school will be offered a list of software that they may chose from as an incentive for their assistance. The software list will not contain any software over $100 and will be paid through the VCU contract. The team members will be reimbursed from the Department of Education. The university members will be reimbursed from the VCU contract.

Each member of the team will take appropriate notes related to the protocol. The site visit team will debrief following the visit. Each member will submit a brief summary of the vignettes, special testimonials, and examples that illustrate the findings that the site team presents on Form 6 (attached).

The university-based consultant is responsible for preparing a 3-5 page paper presenting the findings from the visit. The paper will 1) describe the setting within which the school operates; organize the teams' conclusions according to the areas for inquiry identified in the protocol; and 3) in its concluding paragraphs, seek linkages between program arrangements, activities and outcomes supported by select vignettes, special testimonials, and illustrations. The paper should be submitted within 5 days of the visit.

**DOCUMENTS**

A copy of plans or other appropriate documents that the school has prepared should be gathered and attached to the final report. No attempt should be made to request that information be especially prepared for the site visit except filling out the Equipment Description (Form 2).

**INTERVIEWS**

As appropriate to the site: individual and group interviews will be scheduled with the following groups of people:

Teachers who are: 1) technology-users; 2) non-users of technology, and 3) outstanding teachers who do not use technology;

Administrators, including the principal, assistant principal, and appropriate central office personnel;

Support Staff, including a building technology coordinator, library media specialist and central office technology coordinator;

Students and parents.

**OBSERVATIONS**

In addition to the review of documents and interviews, the site team should attempt to see
as many uses of the technology as possible during their stay.

## AREAS OF INQUIRY

The areas of inquiry will be grouped under the general headings of: Organizational Profile, Technology Profile, and Human Resource Profile. Each area of inquiry contains a set of focus questions (attached) that should guide the site team as to the types of information sought, both in note taking and in drawing their conclusions.

The **Organizational Profile** will describe the setting, and inquire into the beliefs, visions and planning that are driving the technology infusion into the school (Forms 1, 2 and 3).

The **Technology Profile** will describe the technology being used and inquire into the manner it is used in curriculum and instruction (Form 4).

The **Human Resource Profile** will describe the human resources available to the school and inquire into the systems that are supporting the implementation of technology into the school (Form 5).

## DEBRIEFING

Following the site visit and preferably before dispersing, the team will debrief on what they saw, give direction to the case reporter (university member) for the written report. (Perhaps having dinner together before heading home will facilitate this meeting.)

## WRITTEN REPORT

The university member will collect the notes (Form 6) or team members may wish to fax them to the case reporter. The case reporter will develop a draft of the visit within 5 days and fax a copy for review to the team. The case reporter will fax or bring the case to the concluding meeting of the case study team.

## SITE VISITS

### Elementary Schools

Highland Park - Roanoke (model school)
- Urban
- Federal Funding
- Planning
- Multi-Media

Team: Gordon Creasey, Randy Agee, Wes Batten (Coordinator) and Sheary Johnson

### Middle Schools

Short Pump Middle - Henrico - February 3, 1993
- Design
- Restructuring
- County Funds

Team: Jean Weller, Manorama Talaiver, Richard Kravitz (Coordinator) and John Pisapia

### High Schools

Bethal High - Hampton
- Curriculum Integration
- Redesign Conversion
- Urban

Team: Richard Kravitz (Coordinator) Mark Delp, Manorama Talaiver and Sheary Johnson

Rappahannock High - Front Royal
- Rural
- Conversion
- Partnership with Potomac Edison has given a different flavor to technology

Team: Gordon Creasey (Coordinator) Wes Batten, Randy Agee and Sherwood Wang

Form 1

## ORGANIZATIONAL PROFILE

### Demographics

**Protocol:** Please provide the following information:

School Name:_____

Street: _____

City/Zip: _____

Phone: (___)_____

Feeder Schools_____ %Free/Reduced Lunch_____

Community Services Used_____ # Faculty_____

Faculty Average Age_____ Grades_____ Enrollment_____

Enrollment at each grade:

K___1___2___3___4___5___6___7___8___9___10___11___12___

_____ _____

Principal Assistant Principal

_____ _____

Library Media Specialist Technology Resource Person

| Leading Technology-Using Teachers Technology | Technology-Using Teachers | World Class Teachers Who Do Not Use |
|---|---|---|
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |

Form 2

## ORGANIZATIONAL PROFILE

**Protocol:** Please identify the equipment available in your school building and the major teacher utilization.

| EQUIPMENT DESCRIPTION | Y/N | # | VENDOR | MAJOR USE | COMMENTS/ OBSERVATIONS |
|---|---|---|---|---|---|
| Micro Computers | | | | | |
| Local Area Network (LAN) | | | | | |
| File Servers | | | | | |
| Computer Labs | | | | | |
| Laser Printers | | | | | |
| Color Television Sets | | | | | |
| VCRs | | | | | |
| Laserdisc Players | | | | | |
| CD-ROM Players | | | | | |
| CD-ROM Servers | | | | | |
| LCD Projector Panels | | | | | |
| SYSTEMS | | | | | |
| ILSs | | | | | |
| Writing to Read | | | | | |
| Lab 2000 | | | | | |
| Other Systems? | | | | | |
| Distance Learning | | | | | |
| Master Antenna TV | | | | | |
| MECC Subscription | | | | | |

## ORGANIZATIONAL PROFILE

Form 3

**Protocol:**

| The following areas should be explored: | Notes, Illustrations, Comments |
|---|---|

**Focus Area: Belief/Vision**

What is the reason you are using technology in your school? What do you want technology to accomplish with it? How do social factors (departmental relations, administration support, school culture), impact the availability of computer-related technologies in your school? What are your students' beliefs regarding the value of computer-related technologies in their lives, now and in the future? What is your perception of the role of computer-related technologies? Now? 5 years from now? 10 years from now?

Who has the clearest vision of use of technology in your school? school division? Who identified the need for the use of technology in your school? Who are the crucial opinion leaders in your school regarding technology? school restructuring?

**Focus Area: Planning**

Has the school been guided by a division plan? school plan? For the acquisition of technology? Who was involved in planning? Does the plan contain a minimum foundation level of technology? Is there a minimum configuration division will support? Can it vary? What was your approach to planning? How did you go about implementing your approach? Based on your experience, what issues have to be faced by a school/division if they want to successfully implement technology? Are you familiar with the VDOE's 6-year Technology Plan? Did you use it in planning? How?

Form 3 - continued

**Protocol:**
The following areas should be explored:
Notes, Illustrations, Comments

**Focus Area: Implementation:**

Can they identify stages that they went through? What stage are they at? What can you expect at different stages?
Did they have to change curriculum? What was biggest barrier to implementation? Facilitator? Have you integrated technology into the curriculum? If no, why not?

Form 4

## TECHNOLOGY PROFILE

**Protocol:**

| The following areas should be explored: | Notes, Illustrations, Comments |
|---|---|
| **Focus Area: Technology Applications:** For those applications available in the school (listed below), - **ASK:** Why do you use "**Distance learning**"? How do you use it? What do you think its best uses are?<br><br>Why do you use multimedia? etc.<br><br>Telecommunications,<br><br>ILSs,<br><br>DeskTop Publishing,<br><br>MLBs, | Telecommunications. |
| **Focus Area: Instructional Applications:** For the applications listed below, **ASK**: Do you use Drill and Practice software? How often? Why? How do you use it? What specific software would you recommend to other teachers? (Note: ask yourself, how does it support Common Core?)<br><br>Tutorials,<br><br>Simulation,<br><br>Problem-solving,<br><br>Word Processing,<br><br>Spreadsheets,<br><br>Database,<br><br>Graphics, | |

Form 4 - continued

**TECHNOLOGY PROFILE**

**Protocol:**

The following areas should be explored: Notes, Illustrations, Comments

**Focus Area: Integration**

Explain how you have integrated technology into the curriculum/instruction. What has been the most help to you in doing this? How many years did it take to fully integrate the technology?

**Focus Area: Instructional Practice**

Does technology promote cooperative learning? (student-student) collaborative learning? (teacher-student) How? Does technology promote Individualized Instruction? How? What products have your students produced with technology applications? How do you evaluate your students? Do you use standardized tests? performance-based evaluations? What type? How much actual keyboarding time do your students receive? Is there a standard? How do you insure equity? Has the way you teach changed because of the technology you are using? Explain! Do you use your time differently? How?

Form 5

## RESOURCE PROFILE

**Protocol:**

| The following areas should be explored: | Notes, Illustrations, Comments |
|---|---|

**Focus Area: Training**
Explain how long it took to get comfortable using the technology? (1-2 yrs.) What was the nature of the training you received? Were you trained on a specific system/software? Did you receive training that showed you the possibilities of using the technology? What type of training would be the most beneficial to you?

**Focus Area: Software**
Do you review software before using it? Does your division have a review process? How do you know what to order? What type of software would be the most beneficial to you? Has the software modified how you use textbooks?

**Focus Area: Administrative Support**
What type of support is provided by your technology coordinator? Principal? Library media person? What kind of staffing and support is in place? You made the investment -- do you have the support? What support do you need to integrate the technology better than it is now? Were you granted released time, extended contract or paid extra to learn how to integrate technology into your classrooms?

**Focus Area: Facilities**
What changes would you recommend in the design of your classroom to accommodate the technology?

**Focus Area:**
**Teachers' Administrative Uses**
How do you use technology for administration of your classes?

Form 6

## CASE STUDY SUMMARY SHEET

**Protocol:** Please summarize examples, testimonials or illustrations that you observed or were told on the site visit. Turn this sheet in to the case study reporter.

**BELIEF PROFILE**

**ORGANIZATIONAL PROFILE**

**TECHNOLOGY PROFILE**

**HUMAN RESOURCES PROFILE**

**TEACHERS ADMINISTRATIVE USES OF TECHNOLOGY**

**TEACHERS INSTRUCTIONAL USES OF TECHNOLOGY**

**INSTRUCTIONAL SUPPORT SYSTEM**

Administrative Support

Instructional Support

Community Support